Optional Price 20 cents

A Broad Line of Digital Integrated Circuits

RCA

COS/MOS

Featuring Low-Voltage Devices from 3V to 15V

COS-278 Printed in USA/3-71

COS/MOS CD4000A Series INTEGRATED CIRCUITS

For Low-Voltage [3 to 15V] Digital Circuit Designs

The RCA COS/MOS line of digital integrated circuits includes a standard line of devices designed to operate from voltage supplies of 5 to 15 volts, and a new low-voltage "A" Series designed to operate from voltage supplies of 3 to 15 volts.

This Product Guide describes the new "A" Series which is unilaterally interchangeable with and has all the inherent advantages of the currently available CD4000 Series. In addition, the "A" series offers the new features listed below, which now make possible equipment designs requiring IC's operating at low supply voltages and having outstanding electrical performance, high reliability, and simplified circuitry.

- wider supply voltage range
- faster gate propagation delay
- faster flip-flop toggle rates
- characterized over full military operating temperature range of -55°C to +125°C
- supply voltage compatibility with both DTL and T^2L bipolar logic families, eliminates the need for 2nd or 3rd power supplies for clock driver circuits and insures voltage level compatibility when interfacing — — provides direct connection from COS/MOS to bipolar devices in most applications; in other applications, only a single pull-up resistor may be required.

Characteristic	CD4000 Series	CD4000A Series
Supply voltage range	5 to 15 Volts	3 to 15 Volts
Gate propagation Delay (typ)	50ns at V_{DD}=10 volts, C_L=15pF	25ns at V_{DD}=10 volts, C_L=15pF 35ns at V_{DD}=5 volts, C_L=15pF
Flip-Flop Toggle Rate (typ)	3MHz at V_{DD}=10 volts, C_L=15pF	10MHz at V_{DD}=10V, C_L=15pF 4MHz at V_{DD}=5V, C_L=15pF

Maximum Ratings	CD4000 Series	CD4000A Series
Storage Temperature Range	-65°C to +150°C	-65°C to +150°C
Operating Temperature Range: ceramic package types: plastic package types:	-55°C to +125°C -40°C to +85°C	
DC Supply Voltage Range (V_{DD}-V_{SS}) Device Dissipation (per pkg.) All Inputs For types CD4009A, CD4010A	-0.5V to +15V 200mW $V_{SS} \leq V_I \leq V_{DD}$	-0.5V to +15V 200mW $V_{SS} \leq V_I \leq V_{DD}$ $V_{CC} \leq V_{DD}$
Recommended DC Supply Voltage (V_{DD}-V_{SS}) For Developmental Types TA5938, TA5939, TA5987	5 to 15 Volts —	3 to 15 Volts 1.3 to 15 Volts

Typical Characteristics for CD4000A Series at T_A = 25°C, V_{DD} = 5V, C_L = 15 pF

Logic Function	Quiescent Device Dissipation (P_D) μW	Impedance Ω	Noise Immunity (All Inputs) (V_{NL},V_{NH})	Input Capacitance (C_I) pF
Counter/Dividers	0.025 to 2.5	10^{12}	45% of V_{DD}	5
Arithmetic Devices	1.5			
Memories	0.1			
Gates	0.001 to 0.15			
Static Shift Register	0.025 to 2.5			
Flip Flops	0.025			
Hex-Buffer/Logic-Level Converters	0.15			

Developmental-type devices or materials are intended for engineering evaluation. The type designation and data are subject to change, unless otherwise arranged. No obligations are assumed for notice of change or future manufacture of these devices or materials.

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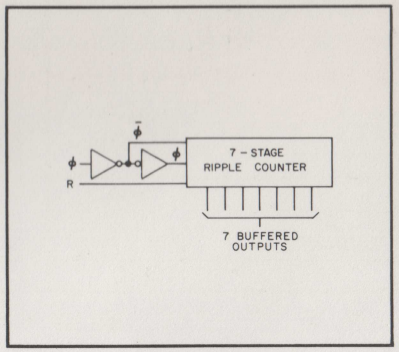
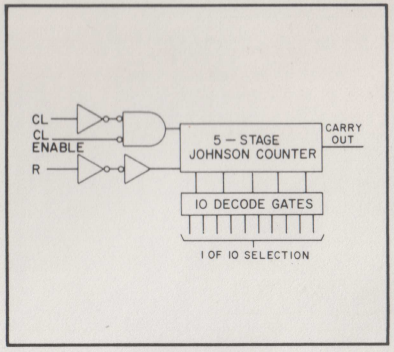
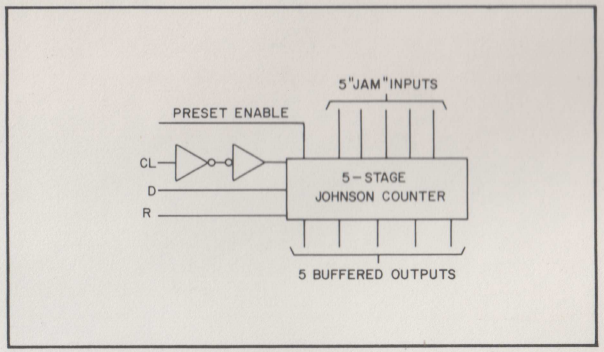
COUNTER/ DIVIDERS



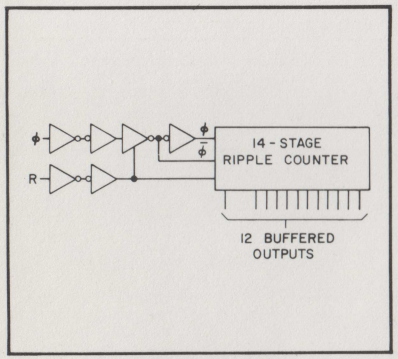
CD4004A Series
7-Stage
Binary Counter
Ripple-Carry Type



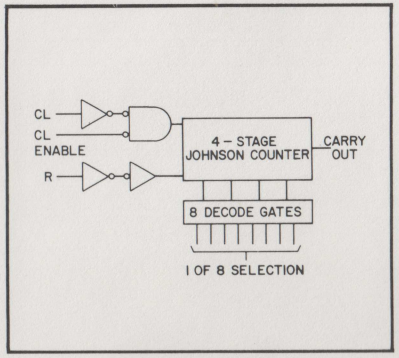
CD4017A Series
Decade Counter/
Divider Plus 10
Decoded Decimal Outputs



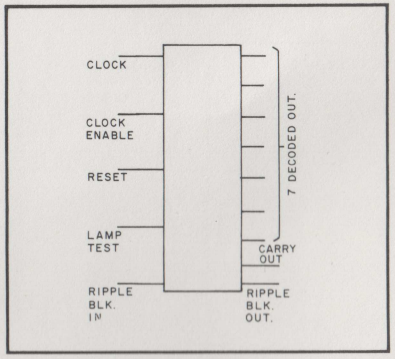
CD4018A Series
Presettable,
Divide-by-"N"
Counter
Fixed or Programmable
Divide by 2 through 10



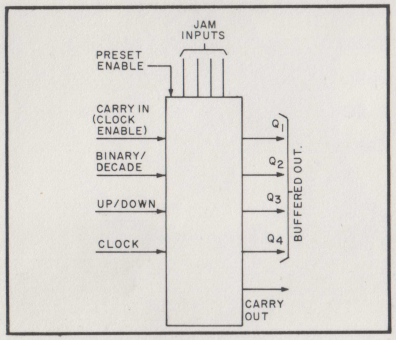
CD4020A Series
14-Stage Binary
Counter/Divider
Ripple-Carry Type



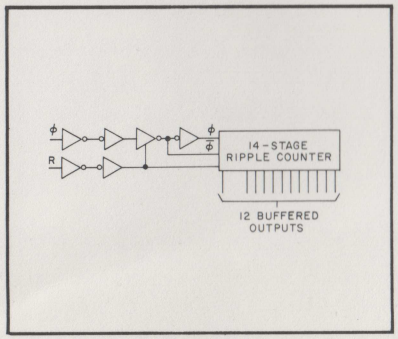
CD4022A Series
Divide-by-8
Counter/ Divider
with 8 Decoded Outputs



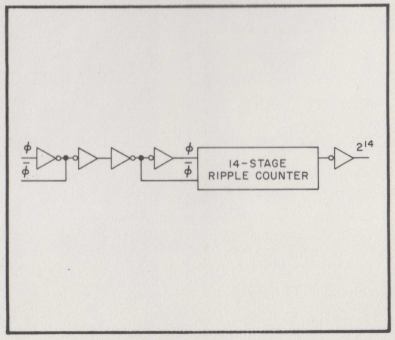
TA5677
Decade Counter/
Divider with 7-
Segment Display Outputs



TA5925
Presettable,
Up/Down Counter,
Binary or BCD-
Decade



TA5938
Ultra-Low-Power,
14-Stage, Ripple
Carry Binary
Counter/Divider
(V_{DD} = 1.3V)



TA5939
Ultra-Low-Power,
14-Stage, Ripple
Carry Binary
Counter/Divider
(V_{DD} = 1.3V)

Typical Characteristics at $T_A = 25^oC$, $V_{DD} = 5V$, $C_L = 15$ pF

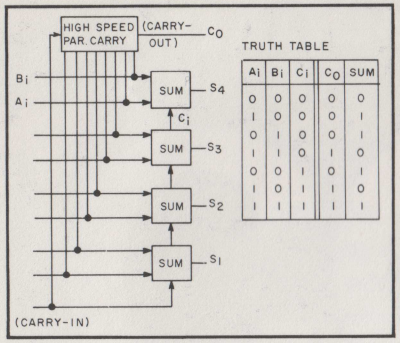
COS/MOS Series	Propagation Delay Time ($t_{PHL} = t_{PLH}$) ns	Output Drive Current N-Channel (I_DN) mA	Output Drive Current P-Channel (I_DP) mA	Max. Clock Freq. (f_{CL}) MHz
CD4004	175	0.5	-0.5	6
CD4017	350	0.5	-0.4	2.5
CD4018	350	0.5	-0.4	2.5
CD4020	150	0.3	-0.25	2.5
CD4022	350	0.5	-0.4	2.4
TA5677	300	–	-1.1*	4
TA5925	–	–	–	–
TA5938	–	0.1	-0.1	0.1†
TA5939	–	0.1	-0.1	0.1†

†V_{DD} = 1.3 volts

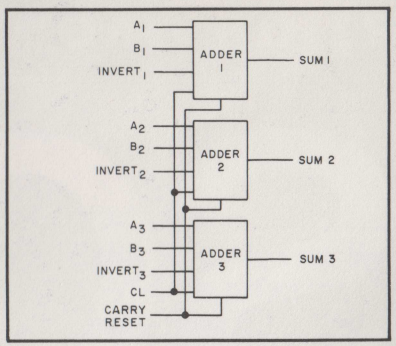
For higher speed operation, refer to 10V characteristics in CD4000A Series bulletin, File 479.

Type Numbers with "TA" prefix are developmental types

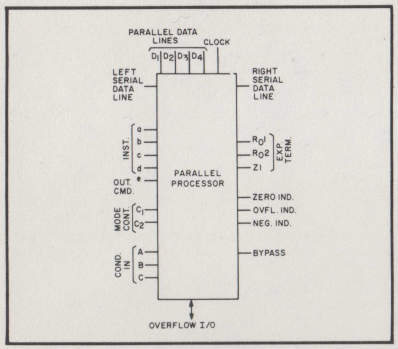
ARITHMETIC DEVICES –
Adders, Decoders



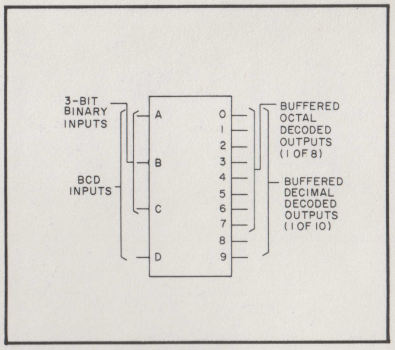
CD4008A Series
Four Bit
Full Adder with
Parallel Carry Out



TA5963
Triple Serial Adder
with Common Clock &
Carry Reset Inputs



TA5716
Parallel Processor



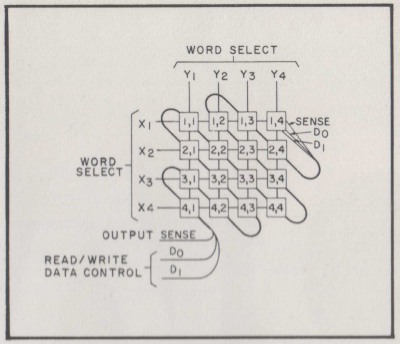
TA5873
BCD-to-Decimal
Decoder

Typical Characteristics
at T_A = 2.5°C, V_{DD} = 5 Volts, C_L = 15 pF

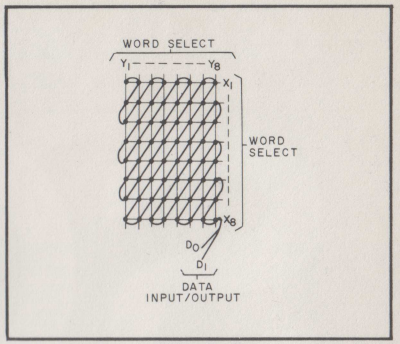
COS/MOS Series "A"	Propagation Delay Time ($t_{PHL} = t_{PLH}$) ns	Output Drive Current N-Channel (I_DN) mA	Output Drive Current P-Channel (I_DP) mA
CD4008	100 (Carry Out) 90 (Sum Out)	+0.5 +0.02	–0.5 –0.02
TA5963	350	1	–0.5
TA5716	–	–	–
TA5873	500	2	–2

For higher speed operation, refer to 10V characteristics in CD4000A Series bulletin, File 479.

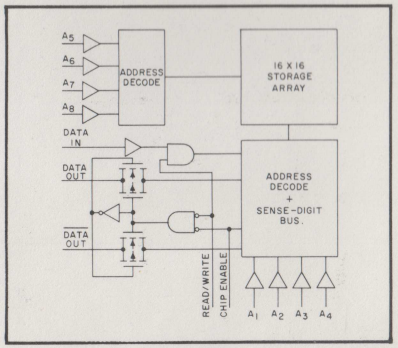
MEMORIES:



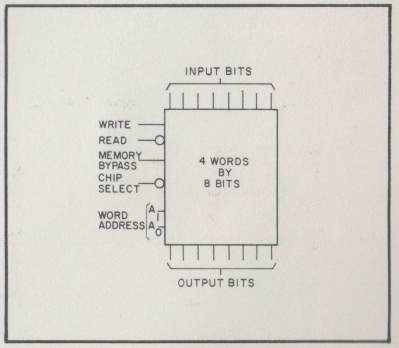
CD4005
16-Bit NDRO
Static RAM
X-Y Select



TA5577
64-Bit NDRO
Static RAM
X-Y Select



TA6042
256-Bit
fully decoded
RAM



TA5926
4 Words X
8 Bits
Word Organized

Typical Characteristics
at T_A = 25°C, V_{DD} = 5 Volts

COS/MOS Series "A"	Readout Delay Time (ns) Read After Read	Readout Delay Time (ns) Read After Write	Sense Current (μA) "1"	Sense Current (μA) "0"	Data Input Current (μA)	Access Time (ns)
CD4005	15	15	1000	10	1000	25
TA5577	50	300	300	0.5	–	50
TA5926	100	100	Logic-Level Sensing Used		–	–
TA6042	–	–	75	0.1	–	200†

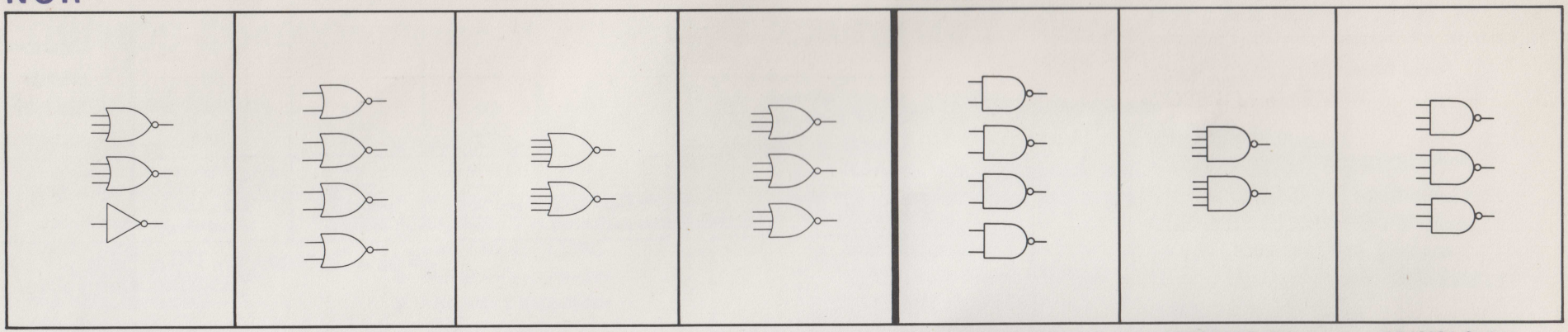
†V_{DD} = 10 volts

Type numbers with "TA" suffix are developmental types.

GATES:

NOR

NAND



CD4000A Series
Dual 3-Input
NOR Gate
Plus Inverter

CD4001A Series
Quad 2-Input
NOR Gate

CD4002A Series
Dual 4-Input
NOR Gate

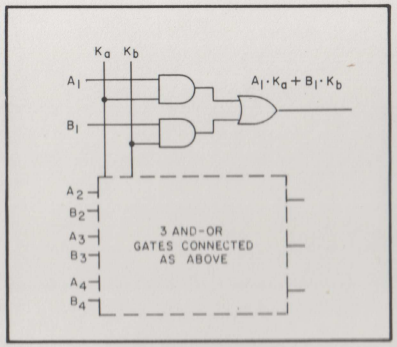
CD4025A Series
Triple 3-Input
NOR Gate

CD4011A Series
Quad 2-Input
NAND Gate

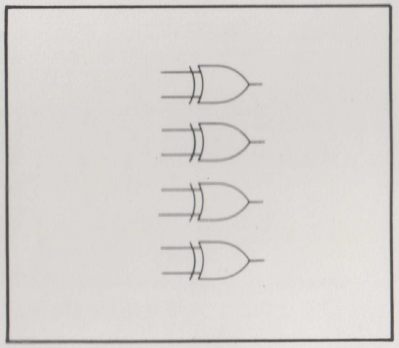
CD4012A Series
Dual 4-Input
NAND Gate

CD4023A Series
Triple 3-Input
NAND Gate

AND/OR Select
Exclusive-OR

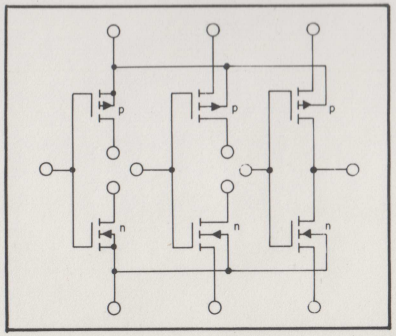


CD4019A Series
Quad AND-OR
Select Gate

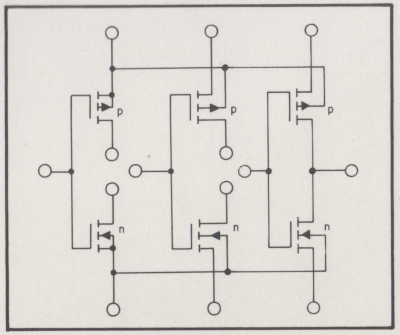


TA5940
Quad
Exclusive-OR
Gate

Comp. Pairs



CD4007A Series
Dual Complementary
Pair Plus Inverter



TA5987
Ultra-Low Power Dual
Complementary Pair, Plus Inverter
(V_{DD} = 1.3V)

Typical Characteristics
at $T_A = 25^oC$, $V_{DD} = 5$ Volts, $C_L = 15$ pF

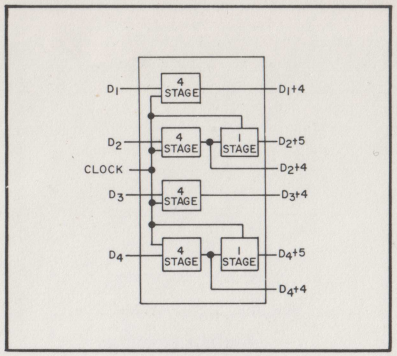
COS/MOS Series "A"	Propagation Delay Time ($t_{PHL} = t_{PLH}$) ns	Output Drive Current	
		N – Channel (I_DN) mA	P – Channel (I_DP) mA
CD4000	35	1	-2
CD4001	35	1	-2
CD4002	35	1	-2
CD4025	35	1	-2
CD4011	50	0.5	-0.5
CD4012	50	0.5	-0.5
CD4023	50	0.5	-0.5
CD4019	100	1.5	-0.5
TA5940	150	1.5	-1
CD4007	35	1	-4.5
TA5987	100†	0.05	-0.05

†V_{DD} = 1.3V

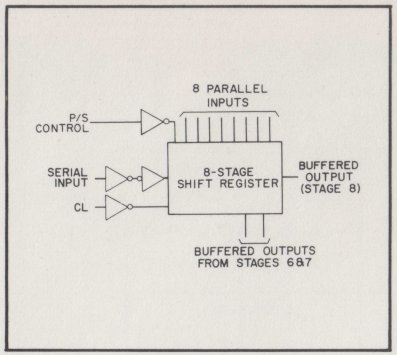
For higher speed operation, refer to 10V characteristics in CD4000A Series bulletin, File 479.

Type numbers with "TA" suffix are developmental types.

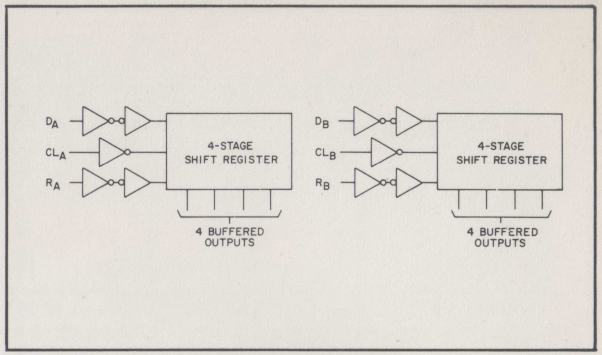
STATIC SHIFT REGISTERS



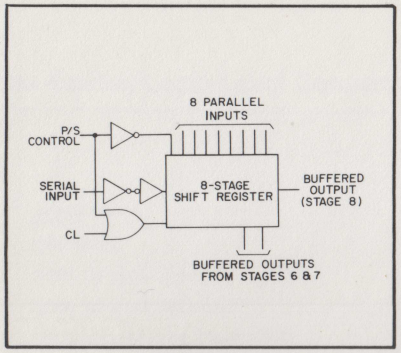
CD4006A Series
18-Stage



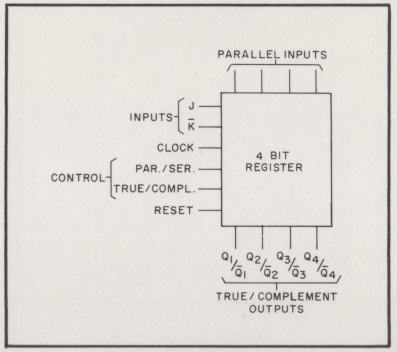
CD4014A Series
8-Stage Synch.
Parallel Input/
Serial Output



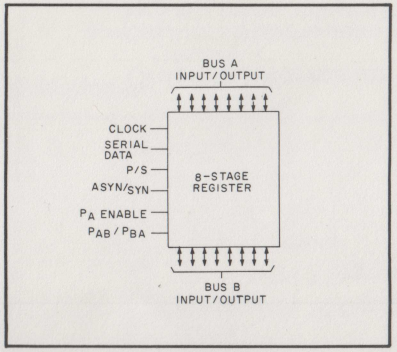
CD4015A Series
Dual 4-Stage
with Serial Input/
Parallel Output



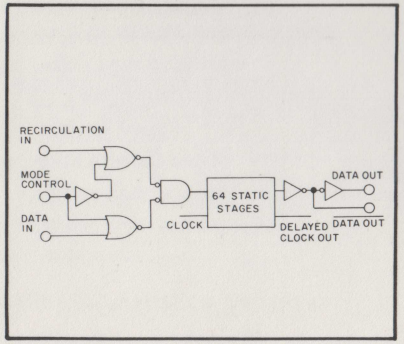
CD4021A Series
8-Stage Asynch.
Parallel Input/
Serial Output



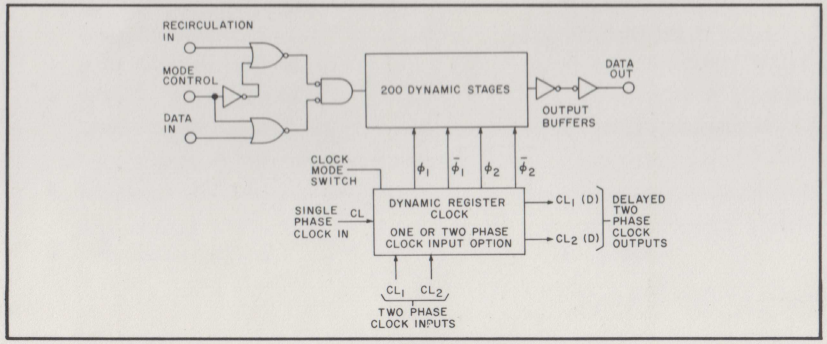
TA5876
4-Bit Parallel/Serial
with J-K Input and
True/Complement Output



TA5878
8-Bit Bidirectional
Parallel/Serial,
Input/Output Bus



TA5989
64-Stage



TA5956
200-Stage Dynamic

Typical Characteristics at $T_A = 25^oC$, $V_{DD} = 5V$, $C_L = 15$ pF

COS/MOS Series "A"	Propagation Delay Time ($t_{PHL} = t_{PLH}$) ns	Output Drive Current N-Channel (I_DN) mA	Output Drive Current P-Channel (I_DP) mA	Max. Clock Freq. (f_{CL}) MHz
CD4006	300	0.25	-0.15	2.5
CD4014	300	0.3	-0.16	2.5
CD4015	300	0.3	-0.16	2.5
CD4021	300	0.3	-0.16	2.5
TA5956	500■	3■	-1.5■	0.75■
	100□	3□	-1.5□	2.5□
TA5876	200	1	-0.5	3.5
TA5878	500	0.1	-0.05	1.5
TA5989	500▲	3▲	-1.5▲	2.5
	500△	0.2△	-0.75△	–

▲Values are for Q; △, for $\overline{Q}$ ■1Φ clock, □2Φ clock

For higher speed operation, refer to 10V characteristics in CD4000A Series bulletin, File 479.

Type Numbers with "TA" prefix are developmental types

COS/MOS CD4000A Series INTEGRATED CIRCUITS

Top Performance Features

- low power –
  10 nW typ. for gates(per pkg.)
  10 μW typ. for MSI circuits(per pkg.)
- wide voltage range
  3 to 15 volts
  (1.3 volts for special types)
- high noise immunity –
  45% of supply voltage (typ.)
- high speed –
  to 10 MHz
- high fanout
  >50
- wide variety of packages
  dual in-line ceramic
  dual in-line plastic
  flat pack
  TO-5 style
- logic compatibility
  T^2L & DTL interfacing
- excellent temperature stability –
  ±1.5% shift in transfer characteristics
  over –55 to +125°C
- inputs fully protected
- high input impedance –
  10^{12} Ω typ.
- clock voltage = supply voltage
- single phase clock
- wide operating temperature range –
  ceramic package types
  –55°C to +125°C
  plastic package types
  –40°C to +85°C

Wide Variety of Logic Functions

- Gates –
  NOR, NAND, Transmission, AND-OR Select, Exclusive-OR, Complementary Pairs
- Shift Registers –
  8 stage, dual 4-stage, 18-stage, 64-stage static; 200 bit – dynamic
- Counters/Dividers
  Binary: Ripple-Carry, 7 & 14 stage
  Presettable: Up-Down, Divide-by-N

  Decade: with 10 Decoded Outputs
  with 7 Segment Display Outputs
- Flip-Flops –
  "D", J-K
- Arithmetic Devices –
  Adders, Parallel Processors
- Decoders –
  BCD-to-Decimal, 3-Bit Binary-to-Octal
- Multiplexers –
  Quad Bilateral Switch
- Hex Buffer/Logic-Level Converters –
  Inverting
  Non-Inverting
- Memories
  16- and 64-Bit NDRO Static RAM
  32-Bit Word Organized
  256-Bit Fully Decoded RAM

Wide Variety of Applications

- Automotive
- Data Terminals
- Instrumentation
- Medical Electronics
- Alarm Systems
- Appliances
- Watches, Clocks
- Industrial Controls
- Remote Metering
- Computers
- Calculators
- Communications –
  Pocket Pagers
  Hand-Held Radios
  Remote Control
  Telemetry
  Synthesizers

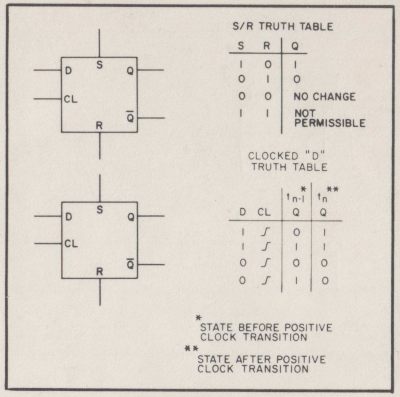
Ordering Information

COS/MOS IC's are available in a wide variety of package designs. These packages are identified by Suffix Letters indicated in the chart shown below. When ordering COS/MOS devices, it is important that the appropriate suffix letter be affixed to the type number of the device required.

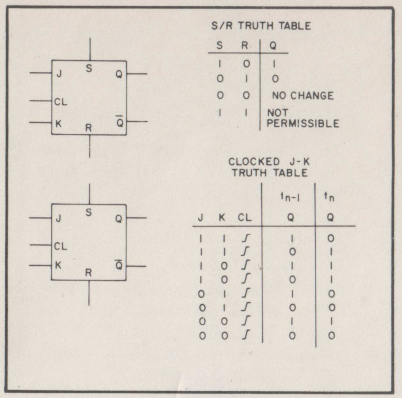
Package	SUFFIX LETTERS		
	Commercial ("CD") Type Numbers		Developmental "TA" Type Numbers
	Standard CD4000 Series (5 to 15 V)	New CD4000A Series (3 to 15 V)	
Dual In-Line Ceramic	D	D	W
Dual In-Line Plastic	E	E	X
Flat Pack	–	K	V
TO-5 Style	T	T	T

For Example: If a low-voltage CD4008 Four-Bit Full Adder in a plastic package is desired order CD4008AE. If a Developmental Type, TA5989 in a plastic package is desired, order TA5989X

FLIP-FLOPS

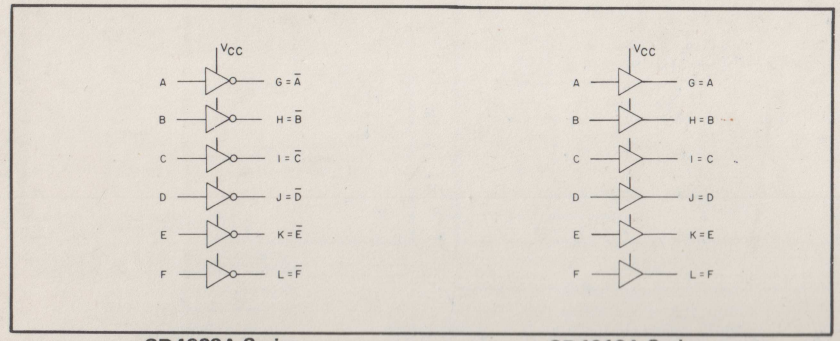

S/R TRUTH TABLE
S R Q
1 0 1
0 1 0
0 0 NO CHANGE
1 1 NOT PERMISSIBLE
CLOCKED "D" TRUTH TABLE
D CL t_{n-1}* Q t_n** Q
* STATE BEFORE POSITIVE CLOCK TRANSITION
** STATE AFTER POSITIVE CLOCK TRANSITION

CD4013A Series
Dual "D" with
Set/Reset Capability



TA5872
Dual J-K with Set/Reset
Capability

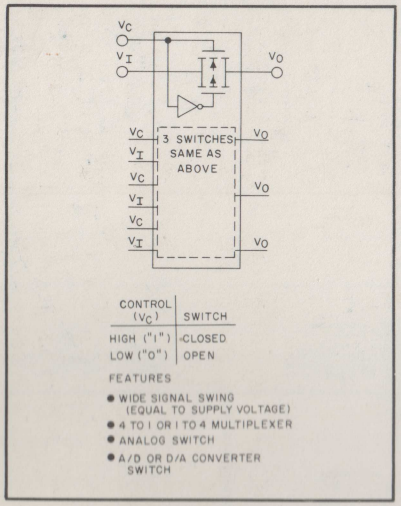
Hex-Buffer/Logic-Level Converters



CD4009A Series
Inverting Type

CD4010A Series
Non-Inverting Type

Multiplexers



CD4016A Series
Quad Bilateral Switch

Typical Characteristics at $T_A = 25^oC$, $V_{DD} = 5$ Volts, $C_L = 15$ pF

COS/MOS Series "A"	Propagation Delay Time ($t_{PHL} = t_{PLH}$) ns	Output Drive Current N-Channel (I_DN) mA	Output Drive Current P-Channel (I_DP) mA	Max. Clock Frequency (f_{CL}) MHz
CD4013	150	1	-0.5	4
TA5872	200	1	-0.5	3.5
CD4009	50	4	-0.4	–
CD4010	50	4	-0.4	–
CD4016	25	–	–	–

For higher speed operation, refer to 10V characteristics in CD4000A Series bulletin, File 479.

Type Numbers with "TA" prefix are developmental types

"When incorporating these devices in equipment, it is recommended that the designer refer to "Operating Considerations for RCA Solid State Devices". (Form No. 1CE-402), available on request from RCA Commercial Engineering, Harrison, N.J. 07029."

COS/MOS IC Data Bulletins

File No. 479, Detailed data on CD4000A Series Types

COS/MOS IC Application Notes

ICAN 6176 Noise Immunity of COS/MOS Integrated Circuit Logic Gates

ICAN-6218 Gate-Oxide Protection Circuit in RCA COS/MOS Digital Integrated Circuits

ICAN-6267 Astable and Monostable Oscillators Using RCA COS/MOS Digital Integrated Circuits

ICAN6498 Design of Fixed and Programmable Counters Using RCA-CD4018 Presettable Divide-by "N" Counter

ICAN-6576 Power Supply Considerations for Systems Using COS/MOS IC's

ICAN-6600 Complete 32-Bit Arithmetic/Logic Unit

ICAN-6166 MSI Counters and Registers Design and Applications

ICAN-6602 Interfacing COS/MOS Logic Circuits with other Logic Families.

COS/MOS IC Reports

RIC-101 COS/MOS IC Reliability Data

RIC-103 COS/MOS CD4000E Series Reliability Data

COS/MOS IC Manual

CMS-270 $2.50 (Optional Price)

For additional information on RCA COS/MOS Digital Integrated Circuits and other Digital Circuits, contact your RCA Sales Representative or write to RCA/Commercial Engineering/Harrison N. J. 07029